

## CHAPTER 8

## IEEE 1394

This chapter summarizes PC 99 design requirements for hardware designed using the current IEEE 1394 standards. The IEEE 1394 high-speed serial bus complements USB by providing enhanced PC connectivity for a wide range of devices, including consumer audio/video (A/V) components, storage peripherals, other PCs, and portable devices.

IEEE 1394 has been adopted by the consumer-electronics industry and is expected to provide a volume, Plug and Play-compatible expansion interface for the PC. The 100-MB/sec, 200-MB/sec, and 400-MB/sec transfer rates currently specified in IEEE P1394.a and the proposed enhancements in IEEE p1394b are well suited to multistreaming I/O requirements.

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## IEEE 1394 Basic Requirements

The following is a summary of the IEEE 1394 design considerations related to PC systems, as addressed in this chapter:

- Compliance with IEEE 1394 standards, specifically IEEE 1394-1995 and IEEE P1394.a
- Support for the 1394 Open Host Controller Interface (OpenHCI) specification for controllers, specifically OHCI Revision 1.0
- Plug and Play support for device configuration, control and status registers (CSRs), connectors and cabling, and connection fault handling
- Cable power distribution, including requirements for source devices, sink devices, self-powered devices, and supporting CSRs
- Device power management, CSRs, and soft-power protocols
- Device command protocols for audio, video imaging, still imaging, and storage device classes

This section defines the basic PC 99 requirements for IEEE 1394.

### **8.1. Controllers and devices support mandatory features in IEEE P1394.a with backward compatibility with IEEE 1394-1995**

*Required*

Designs that interface to the IEEE 1394 bus must support the following industry standards and supplemental specifications:

- IEEE 1394-1995 standard
- IEEE P1394.a, an amendment to IEEE 1394-1995
- IEEE 1212-1991 and function discovery in IEEE 1212-199x

### **8.2. Controllers comply with OpenHCI for IEEE 1394**

*Required*

The 1394 OpenHCI Revision 1.0 specification for IEEE 1394 defines standard hardware and software for PC connections to the IEEE 1394 bus. OpenHCI defines standard register addresses and functions, data structures, and DMA models. The benefits of this standard include improved performance, security, and error handling.

A 1394 OpenHCI device is bus manager-capable, including bus mastering for BANDWIDTH\_AVAILABLE and CHANNELS\_AVAILABLE registers.

Host adapters and host controllers must implement the mandatory features of 1394 OHCI Revision 1.0, including support for a minimum of four isochronous transmit contexts, four isochronous receive contexts, two asynch transmit contexts, two asynch receive contexts, self ID context, and physical DMA.

Devices that implement 1394 and are not bus managers or bus controllers are not required to implement an OpenHCI-compliant host controller in their Link.

### 8.3. OpenHCI controllers and devices support advances defined in IEEE P1394.a

#### *Required*

The advances in the IEEE P1394.a specification enhance system performance and integration of component systems. The mandatory features specified in IEEE P1394.a must be supported by all host controllers, peripherals, and Link physical layer device (PHY) components. Mandatory IEEE P1394.a features that must be supported by all devices and controllers include:

- S100–S400 operation of all PHY ports in host controllers
- S100–S400 operation of all device-side PHYs
- PHY autonomous features for connection debounce and hysteresis
- Arbitration enhancements that promote a high quality of operation and end-user experience

### 8.4. Host supports peak data rate of 400 MB/sec, minimum

#### *Required*

The integration of component systems that enable concurrent applications demands minimum bandwidth for an effective user experience. A peak data rate of 400 MB/sec is required of all host controllers and PHY ports available externally in the system for 1999. The host controller must support 100-MB/sec, 200-MB/sec, and 400-MB/sec data rates as specified in IEEE 1394-1995 and IEEE P1394.a. All externally-accessible host controller ports must support S100-400 operation.

### 8.5. Design avoids excessive currents resulting from ground-fault potential among devices

#### *Recommended*

PC-based peripherals are not required to implement isolation because of the usual assumption of a common green-wire ground for all linked devices. Accordingly, the requirement for electrical isolation has been targeted for removal from the IEEE standard. If optional galvanic isolation is implemented, it should conform to the P1394.a specification, which replaces references in IEEE 1394-1995 Annex A and Annex J.6. Power supply, PHY power, connector power, and cable power isolation with appropriate ground returns for signal ground and power “green wire ground.” Systems that could connect to devices or other systems where a ground fault potential can exist should implement good isolation design practices.

Other bodies, such as IEC, UL, and ANSI, govern safety and regulatory considerations for computers, networks, and consumer electronics devices. IEEE 1394 systems and devices should conform to the appropriate safety and regulatory concerns in this area. The exact specification for each class of device or system is outside of the scope of this design guide.

For local area network (LAN) configurations, it is desirable to avoid excessive currents resulting from ground-fault potential among devices. The related design problem can be solved for such configurations by building isolation into the power supply and by AC coupling of the PHY and Link interface of selective AC-powered subsystems.

## Requirements for IEEE 1394 Devices

This section summarizes additional requirements for IEEE 1394 peripherals such as consumer-electronics devices.

### 8.6. Device command protocols conform to standard device class interfaces

*Required*

IEEE 1394 storage class devices must conform to the IEC 61883 standards for the CIP (Common Isochronous Packet) format, the CMP (Connection Management Procedures) procedures, and the FCP (Function Command Protocol) protocols.

### 8.7. Devices support peak data rate of 400 MB/sec, minimum

*Required*

For PC 99 designs, S400 IEEE 1394 devices are recommended; S100 devices are strongly discouraged; and S200 devices should limit their peak bus utilization to less than 50 percent.

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For a device with more than one port, each port must support S100, S200, and S400 PHY operations. All new peripherals and systems should use S400 PHY ports. Existing devices using only S100 or S200 PHY ports are acceptable.

Also, application bandwidth can be limited by speed traps (a slow device separating two faster devices), which impose speed-dependent cabling considerations on the end user.

### 8.8. Devices requiring support for high-bandwidth data transfer use IEEE 1394

*Recommended*

For devices that require support for high-bandwidth data transfers and Plug and Play connectivity, the IEEE 1394 bus is recommended. Such devices include the following:

Component audio	Magneto-optical devices
Connectivity peripherals	PC docking stations
Digital camcorder	Printers
Digital VCR	Set-top television controllers
DTV	Video conferencing cameras
DVD and CD drives	Archival storage (tape, high density disk, cartridge, or other removable memory media)
Hard disk drives	
High-resolution scanners	

## Plug and Play for IEEE 1394

This section summarizes the Plug and Play requirements for IEEE 1394 peripheral devices and PC host controllers.

### 8.9. Plug and Play devices demonstrate interoperability with other devices

#### *Required*

All devices must support Plug and Play for intended applications in both a minimal and an extended bus configuration. A minimal configuration is the minimum number of devices necessary to demonstrate the primary application of the device. An extended configuration is an advanced application with at least two devices added to the minimal configuration. The added devices can be extraneous to the application.

The following is a summary of compliance testing guidelines for this requirement:

- Intended applications must be documented before testing.
- Both test configurations must consist of a core matrix of stable devices that have demonstrated full interoperability in the absence of the test device. To be included in the core test matrix, a device must have demonstrated compliance of its PHY, Link, and Transaction layers as specified in the IEEE 1394-1995 and P1394.a standards.
- The core matrix of devices must be established by an independent agency with actual testing performed by an independent third party or as part of an industry compatibility workshop.
- IEEE 1394 devices and systems must meet the Personal Computer Compatibility and Interoperability profile, independent of their additional use as peer-to-peer or non-PC devices.
- IEEE 1394 devices must conform to the Plug and Play guidelines as applied to IEEE 1394 devices. For a reference to the Plug and Play guidelines, see <http://www.microsoft.com/hwdev/onnnow.htm>.

### 8.10. Topology faults do not cause the bus to fail

#### *Required*

Standard IEEE 1394 protocols have been defined to eliminate topology faults. However, to ensure correct implementation, the following items describe test criteria for industry compatibility workshops. In each case, connection or removal of a device must not stall the bus, but the faulting device might not function. The PC must detect each fault. The compliance criteria include the following:

- Surprise removal. All isochronous-capable devices must support the Connection Management Protocol specified in IEC 61883 (or the most recent specification) in order to resume streaming connections following a bus reset and to de-allocate channels upon surprise removal of a device.
- Safe removal. All devices that provide a front-panel power switch must signal the operating system in response to a local shut-down request (hot unplugging) in order to allow safe removal. Safe removal requires that the end user monitor the PC bus manager's response to the request before removing the device.

- Greater than 16 hops. If the bus extends beyond 16 hops or total distance exceeds the maximum cable length and maximum number of nodes/hops, appropriate mechanisms such as PHY pinging and preservation of adequate timing margins must be used. For bus faults generated by cable delays or scenarios where the bus topology exceeds 16 hops, 63 nodes must be detected, reported, and correctable to the end user.
- Greater than 63 devices on a local IEEE 1394 bus. If the 63-device limit is exceeded, the 64th and later devices will be assigned a physical ID of 63. The 64th device must be detected by the bus manager and must provide a warning message to the user.

#### **8.11. Removable media devices support media status notification**

##### *Required*

Removable media devices must use an electronic switch to notify the bus manager in the event of media change requests. This is necessary to enable device applications to lock, unlock, and eject media.

Removable devices must conform to either the National Committee for Information Technology Standards (NCITS) Reduced Block Command (RBC) set standard or to the SFF 8090, Revision 2.0 specification. The MMC-2 specification, when it is approved, will replace SFF 8090.

#### **8.12. Devices that can initiate peer-to-peer communications also support remote programming**

##### *Required*

To enhance systems integration, all devices capable of initiating peer-to-peer communications and are designed for use with the PC must also support a programming language that enables remote control for PC applications. This allows a third device, such as a PC or device controller, to initiate data transmission between two devices.

## **Plug and Play for Device Configuration ROM**

This section defines the Plug and Play requirements related to device configuration ROM.

#### **8.13. Device provides a configuration ROM for unique device identification**

##### *Required*

For Plug and Play device control, the device configuration ROM must provide configuration information as specified in the Revision 2.0 P1394.a standard and as outlined in the configuration ROM table. The configuration ROM is required for unique detection of the device and is used by the PC to enumerate the bus and to load the correct device driver.

For up-to-date information about the configuration ROM under Windows 98 and Windows NT 5.0, see the information about IEEE 1394 on the web site at <http://www.microsoft.com/hwdev/busbios/>.

### 8.14. Device configuration ROM implements general ROM format

#### Required

The general configuration ROM format is specified in the IEEE 1394-1995 and ISO/IEC 13213:1994 standards. The general ROM format is an extensible tree structure that enables a managed environment by providing node-specific and unit-specific information as required for Plug and Play, power management, and isochronous data transfers. The general ROM format also provides for definition of multifunction device units. The bus information block and root directory of the general ROM format are required as specified in configuration ROM table.

### 8.15. Bus information block implemented at a base address offset of 0404h

#### Required

The format of the bus information block is defined by the IEEE 1394-1995 standard. The first quadlet of the bus information block at offset 404h is the configuration ROM signature field used to identify an IEEE 1394 configuration ROM. This quadlet must contain the ASCII string “1394.” The second quadlet of the bus information block at offset 408h contains several bits that indicate node capabilities. These bits are defined as shown in the following table, together with their required values.

**Note:** All devices must support the *irmc*, *cmc*, *isc*, *bmc*, and *pmc* bits and, for host controllers, all these bits must be 1.

#### Bits Indicating Node Capabilities at Offset 408h

Bit or field	Value and description
<i>irmc</i> bit	Indicates that the node supports isochronous resource manager capabilities.
<i>cmc</i> bit	Must be 1 if the node supports cycle master capabilities; otherwise, this value must be 0.
<i>isc</i> bit	Must be 1 if the node supports isochronous operations; otherwise, this value must be 0.
<i>bmc</i> bit	Indicates that the node supports bus manager capabilities.
<i>pmc</i> bit	Indicates that the node is power manager capable. The <i>pmc</i> bit is not defined by the IEEE 1394-1995 standard and is an extension created by this specification.
<i>cyc_clk_acc</i> field	Specifies the accuracy of the node's cycle master clock in parts per million. If the <i>cmc</i> bit is 1, the field's value must be between 0 and 100. If the <i>cmc</i> bit is 0, this field must be all ones.
<i>Max_rec</i> field	Defines the maximum payload size of a block-write transaction addressed to the node. The range of the maximum payload size is from 4 to 2048 bytes. A <i>max_rec</i> value of 0 indicates that the maximum payload size is not specified. Otherwise, within the range of defined payload sizes, the maximum size is equal to $2^{\text{max\_rec} + 1}$ . The <i>max_rec</i> field does not place any limits on the maximum payload size in asynchronous data packets—either requests or responses—that the node might transmit.

### 8.16. Configuration ROM provides globally unique device ID

#### Required

The third and fourth quadlets of the bus information block of the configuration ROM must provide a globally unique device ID, which appears in configuration ROM table beginning at offset 40Ch. This unique 64-bit node ID is the only way to recognize the presence of a given device, because the physical device addresses can change following a bus reset. The unique ID is required for device detection and PC device driver loading.

If a bus node supports multiple units, then the unique 64-bit ID must not be referential to any one unit directory in order to allow for unique identification of a unit in a multifunction device.

The globally unique device ID in the bus information block must be invariant when read with quadlet read requests—it must not be alterable in any way by software.

#### **8.17. Root directory is located at a fixed address following the bus information block**

##### *Required*

The root directory must be located at a fixed address following the bus information block. All other directories and leaves are addressed by entries in their parent directories, starting with the root directory. The root directory contains pointers to the root-dependent directory, a node-power directory as specified in *1394 Trade Association Power Specification, Part 3: Power State Management*, and unit directories for each independent device function.

#### **8.18. Configuration ROM includes a unit directory for each independent device function**

##### *Required*

A unit directory is required for independent function and control of each device unit. A valid pointer to a unit directory must be provided at offset 0x20h, in compliance with the general ROM format specified in IEEE 1394-1995 and the directory format specified in ISO/IEC 13213:1994.

#### **8.19. Each unit directory provides a valid Unit\_Spec\_Id and Unit\_Sw\_Version**

##### *Required*

Within a unit directory, Unit\_Spec\_Id identifies the specification authority and Unit\_Sw\_Version identifies the particular document describing the unit. When added to the beginning of Unit\_Spec\_Id, then Unit\_Sw\_Version uniquely identifies the unit's software interface.

#### **8.20. Each unit directory provides a pointer to a unit-dependent directory**

##### *Required*

The unit-dependent leaf directory must provide additional information about the device unit's vendor and model in associated leaf directories. The format of the information contained in the vendor and model leaves is specific to Unit\_Spec\_Id and Unit\_Sw\_Version.

A valid pointer to a unit-dependent directory must be in accordance with the generic directory format specified in ISO/IEC 13213:1994. The unit-dependent directory must provide valid pointers to vendor and model leaves.

#### **8.21. Vendor and model leaves support textual descriptor leaf format**

##### *Required*

Textual descriptors are required for Unit\_Spec\_ID and Unit\_Sw\_Version entries in the configuration ROM in order to display this information to the user. Textual descriptors are recommended for all other configuration ROM entries. Each textual descriptor points to a leaf that contains a single character string.

Alternately, the textual descriptor can point to a directory that points to one or more textual descriptor leaves corresponding to supported languages. Leaf format and textual descriptor leaves are specified in ISO/IEC 13213:1994.



Textual descriptor leaves must include the following:

- The `spec_type` field must be “0” to correspond to a 24-bit `specifier_id` for a standards body, or “1” to correspond to a 24-bit `specifier_id` for a defining vendor `company_id`.
- The `language_id` field must be derived from the Windows NT locale number (a quadlet), OR’d with 0x80000000.
- Text `string_info` must be in ASCII for any `language_id` in the range 0–7ffffff or in Unicode for any `language_id` in the range 0x80000000–0xffffffff.

## 8.22. Unit-dependent directory provides a pointer to the unit’s CSRs

*Required*

Each unit’s CSRs must be in separate, non-overlapping address spaces to maintain independent device control. If CSRs can be used to interact with a device unit, the unit-dependent directory must provide a pointer to the base address of the unit’s CSRs. This provides an easy way for an application or a device driver to access the unit’s CSRs.

# Plug and Play for Cabling and Connectors

This section defines the Plug and Play requirements for IEEE 1394 cabling and connectors.

## 8.23. Device provides more than one connector port

*Recommended*

Devices should provide at least two (preferably three) 6-pin connector ports for optimum cabling options, subject to cable-power distribution constraints. Fewer than three ports promotes long daisy chains, increasing the potential for speed traps. Therefore, three-port IEEE 1394 device nodes are recommended, with exceptions noted in requirement 8.24, “Device uses the approved IEEE P1394.a connector.”

For internal-only devices, a minimum of two ports enables daisy chaining of devices. However, a limit of 15 hops (end-to-end distance) restricts total devices to 16, sufficient for most internal configurations.

Single port devices are permissible, but it is recommended that devices provide more than one port to enable connectivity to other peripherals when the system does not provide multiple ports.

Devices that consume cable power should be limited to a single connector to encourage short source-to-sink power delivery while eliminating the build up of voltage drop associated with a long daisy chain of power consumers.

*Mobile PC Note*

Only one external port is recommended for mobile systems.

## 8.24. Device uses the approved IEEE 1394 connectors

*Required*

Recommended: Device uses a 6-pin connector.

If the device implements a 4-pin connector, it must be a single port, leaf device because the connector cannot pass cable power to other devices. The connector must conform to the 4-pin connector in the IEEE P1394.a specification.

If the device uses the 6-pin connector, it must also conform to the specifications for connectors in IEEE P1394.a. It is recommended that all PC peripheral devices implement the 6-pin connector. All host controller ports that are externally accessible should support the 6-pin connector. Consistent use of the standard 6-pin IEEE 1394 connector eliminates an undesirable break in the power bus for power-dependent device applications. Other benefits include volume pricing and consistent electrical performance. Therefore, all external pluggable IEEE 1394 devices must use the standard 6-pin IEEE 1394 connector. The exception is an option to use the 4-pin IEEE P1394.a connector for miniature single-port (leaf-node) devices, as defined in requirement 8.26, “Only single-port leaf-node devices use 4-pin connectors.”

Device designers can decide to use the connector described in *the Device Bay Specification, Version 1.0*. If so, the design must be compliant with all connector and electrical requirements of that specification.

#### **8.25. Self-powered devices propagate the power bus through each connector**

*Required*

Self-powered devices that provide their own power source and do not consume cable power must maintain the electrical integrity of the power bus for other devices dependent on it. Therefore, all self-powered devices must propagate the power bus through each connector.

#### **8.26. Only single-port leaf-node devices use 4-pin connectors**

*Required*

A 4-pin connector is not recommended because it adds an additional, and possibly confusing, cable choice for end users. Therefore, under these guidelines, a 4-pin (powerless) A/V connector can only be implemented for single-connector leaf-node devices.

#### **8.27. Device connectors exhibit common speed and power characteristics**

*Required*

Devices with multiple connectors must exhibit common characteristics at each connector to reduce end-user cabling choices. All connectors on a device must exhibit homogeneous speed, power, and mechanical characteristics such that:

- Multiconnector devices use the 6-pin connector.
- All device connectors propagate the power bus
- All device connectors support a common peak data rate

Optionally, all devices providing cable power through 6-pin connectors must provide diode isolation as specified in the *1394 Trade Association Power Specification Part 1: Cable Power Distribution*.

#### **8.28. Standard S400-rated IEEE 1394 cable is provided with devices**

*Required*

For Plug and Play, it is important to use one standard-performance cable for all device configurations to eliminate cable choices for the end user. This is especially important given the range of devices possible on an IEEE 1394 bus. A mix of cable types and ratings creates an unfriendly user experience. Therefore, all cables must have a minimum S400 rating and, if bundled, must be shipped with a standard cable.

## Plug and Play Power Interfaces

This section summarizes Plug and Play requirements for cable power distribution.

For Plug and Play, all devices—whether cable or self-powered—must comply with the applicable requirements in *1394 Trade Association Power Specification, Part 3: Power State Management*. These requirements enable a power management-capable bus manager to provide instant-on application support while reducing system-wide device power consumption.

In addition, all devices must comply with the *1394 Trade Association Power Specification Part 1: Cable Power Distribution*. Although the requirements for devices that do not consume or produce cable power are minimal, all devices share responsibility for propagating the power bus as defined in the Cable Power Distribution specification.

A standard cable-power distribution model is necessary to reduce the likelihood of power-fault conditions, such as insufficient power for connection of a cable-powered device and surprise removal of a device power source. In addition, a bus manager that is power management-capable can allocate or de-allocate available power within diode-isolated power domains, accounting for the overall power budget and voltage drop.

Plug and Play requirements in this section highlight details specified in the applicable power specifications.

### Mobile PC Note

Exceptions for power interfaces for mobile systems are defined in Chapter 6, “Mobile PC 99.”

### 8.29. Devices provide sufficient power to their PHY at all times

#### Required

The host controller and all devices that have more than one port must perform the bus repeater function when powered down as specified in the IEEE P1394.a specification. A device power switch must supply local power to the PHY when the device is powered off, either from a local source or cable power. The host controller PHY can be powered from auxiliary (Vaux) power such as cable power from another cable source provider or suspend power in the host PC.

### 8.30. Devices report power source and cable power consumption in Self\_id packet

#### Required

The host controller and all self-powered devices must report zero power consumed in the power class field of the Self\_id packet. Alternately, if a device consumes cable power only to keep its PHY alive, it must report this consumption in the Self\_id packet. This allows the power manager to reserve power for this occasion.

### 8.31. Devices implement link power control

#### Required

The host controller and all cable-powered and self-powered devices must implement the Link\_on packet and Link\_off bit in the State\_Clear register. These controls allow a power management-capable bus manager to control the node's power state. Access to the device configuration ROM must be possible following a Link\_on. A device cannot increment its power consumption by more than 3 watts following a Link\_on. Self-powered devices can power up with Link\_on. However, cable-powered devices must rely on power manager to enable their link.

### **8.32. Device requiring power increments in excess of Link\_on implements unit-power CSRs**

#### *Required*

The host controller and all cable-powered and self-powered devices require power increments in excess of Link\_on power must implement standard unit-power CSRs as specified in *1394 Trade Association Power Specification, Part 3: Power State Management*. This is necessary for seamless integration of centralized power management capabilities when a device is connected to a mini-system.

In addition, all devices of a given device class must implement a standard set of unit power states as specified in the device class power management specification for that device class. For example, all VCRs must exhibit a consistent behavior with respect to power states and transitions between states. This is necessary to provide a consistent user experience.

**Note:** Please check with the 1394 Trade Association or send e-mail to 1394@microsoft.com to determine whether a power class specification exists for your device type. Alternatively, you are encouraged to draft a proposal for your device type and submit it to the 1394 Trade Association architecture working group for review and approval.

### **8.33. Devices that source cable power must report this capability**

#### *Required*

This reporting is necessary to enable centralized power management. A device that sources 20 volts or more of cable power at 15 watts minimum must report that it provides power in its Self\_id packet as specified in IEEE 1394-1995. Devices that provide less than 20 volts at 15 watts can be discovered using configuration ROM information as described in *1394 Trade Association Power Specification, Part 3: Power State Management*.

### **8.34. IEEE 1394-enabled PC sources cable power**

#### *Required*

An AC-powered PC must source cable power to the bus. Cable power, in turn, enhances Plug and Play with a single connection for low-cost cable-powered devices. Battery-powered mobile and notebook devices are exempt from this requirement, whether or not the device is connected to an AC adapter.

Minimum power wattage is defined in the following item.

### **8.35. Power source supplies a minimum of 20 volts at 15 watts**

#### *Recommended*

If the power provider specifies a power capability greater than 15 watts, it must be capable of providing that power under full load. A power provider is required to always be able to provide its stated power under full load conditions.

For example, a minimum 20 watts output will ensure delivery of only 15 watts to a load some distance away from the source device. This is because of a cable voltage drop of 5 volts:  $1 \text{ amp} \times 0.66 \text{ ohm} \times 7 \text{ to } 8 \text{ cable hops}$  separating source node from sink node at a rated cable-hop resistance of 0.66 ohms. The voltage at the load will drop to 15 volts, with the source current limited at 1 amp. Therefore, a practical design target for a cable power source is a minimum of 20 volts with a current limit of 1 amp.

A device such as a notebook that wants to source less than 20 volts can do so. The device must report in its Self\_id packet that it does not source and in its configuration ROM the exact power it provides.

**8.36. Devices notify the power manager of power change requests***Required*

The host controller and all devices that produce or consume cable power must use an electronic power switch to notify the power manager of requests from the front panel to change the power state. This function must be accomplished using the notification request protocol specified in *1394 Trade Association Power Specification, Part 3: Power State Management*. This protocol provides a time-out for defaulting to local control as is necessary for operation in non-power-managed environments.

This same mechanism is required for safe removal of a device (hot unplugging).

## Power Management for IEEE 1394 Devices

All devices on the IEEE 1394 bus must comply with the power management requirements outlined in this section.

**8.37. Devices and controllers comply with Cable Power Distribution specification***Required*

The cable power distribution model has been defined to provide guidelines for implementation of devices that propagate, source, or sink cable power. Thus, all devices must satisfy power distribution requirements. *1394 Trade Association Power Specification Part 1: Cable Power Distribution* addresses interoperability and power distribution necessary for operation of both power-managed bus configurations and, with some restrictions, unmanaged bus configurations.

**8.38. Devices and controllers comply with IEEE 1394 power specification***Required*

Power-management CSRs and protocols provide an enhanced Plug and Play experience for end users. All devices must support power-state, power-capabilities, and power-status commands as defined in *1394 Trade Association Power Specification, Part 3: Power State Management*. Cable-power devices must support the notification request protocol. Wake-up and battery-status CSRs are optional but recommended.

## IEEE 1394 References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

1394 Trade Association

E-mail: [1394-sig@1394ta.org](mailto:1394-sig@1394ta.org)

<http://www.1394ta.org>

*1394 Trade Association Power Specification Part 1: Cable Power Distribution*

*1394 Trade Association Power Specification, Part 3: Power State Management*

<ftp://ftp.p1394pm.org/pub/p1394pm/>

*Device Bay Specification, Version 1.0*

<http://www.device-bay.org>

*IEC 61883 Digital Interface for Consumer Electronic Audio/Video Equipment*

<http://www.iec.ch>

## IEEE 1394 Standards

ASK\*IEEE

Telephone: (800) 949-4333

Fax: (212) 310-4091

E-mail: askieee@ieee.org

Global Engineering Documents

Phone: (800) 854-7179 (US)

(613) 237-4250 (Canada)

(303) 792-2181 (Outside North America)

Fax: (303) 397-2740

*ISO/IEC 13213:1994 Control and Status Registers (CSR) Architecture  
for Microcomputer Buses*

<http://www.iso.ch/cate/d21416.html>

Information about IEEE 1394 implementations

<http://developer.intel.com>

<http://www.microsoft.com/hwdev/busbios/>

Microsoft Windows NT 5.0 DDK

MSDN Professional membership

*MMC-2 Multi-Media Command Set-2*

<ftp://ftp.symbios.com/pub/standards/io/t10/drafts/mmc2/mmcxxx.pdf>

*National Committee for Information Technology Standards (NCITS) Reduced  
Block Commands (RBC) Draft Proposal T10/97-260r0*

<ftp://ftp.symbios.com/pub/standards/io/t10/drafts/rbc/>

*Open Host Controller Interface Specification*

<ftp://www.austin.ibm.com/pub/chrptech/1394ohci/>

Plug and Play specifications

<http://www.microsoft.com/hwdev/respec/>

Vendor ID registration: [pnpid@microsoft.com](mailto:pnpid@microsoft.com)

SFF 8090 Committee publications

FaxAccess: (408) 741-1600 (fax-back)

Fax: (408) 867-2115

## Checklist for IEEE 1394

If a recommended feature is implemented, it must meet the PC 99 requirements for that feature as defined in this document.

*8.1. Controllers and devices support mandatory features in IEEE P1394.a with backward compatibility with IEEE 1394-1995*  
*Required*

*8.2. Controllers comply with OpenHCI for IEEE 1394*  
*Required*

*8.3. OpenHCI controllers and devices support advances defined in IEEE P1394.a*  
*Required*

*8.4. Host supports peak data rate of 400 MB/sec, minimum*  
*Required*

*8.5. Design avoids excessive currents resulting from ground-fault potential among devices*  
*Recommended*

*8.6. Device command protocols conform to standard device class interfaces*  
*Required*

- 8.7. *Devices support peak data rate of 400 MB/sec, minimum*  
Required
- 8.8. *Devices requiring support for high-bandwidth data transfer use IEEE 1394*  
Recommended
- 8.9. *Plug and Play devices demonstrate interoperability with other devices*  
Required
- 8.10. *Topology faults do not cause the bus to fail*  
Required
- 8.11. *Removable media devices support media status notification*  
Required
- 8.12. *Devices that can initiate peer-to-peer communications also support remote programming*  
Required
- 8.13. *Device provides a configuration ROM for unique device identification*  
Required
- 8.14. *Device configuration ROM implements general ROM format*  
Required
- 8.15. *Bus information block implemented at a base address offset of 0404h*  
Required
- 8.16. *Configuration ROM provides globally unique device ID*  
Required
- 8.17. *Root directory is located at a fixed address following the bus information block*  
Required
- 8.18. *Configuration ROM includes a unit directory for each independent device function*  
Required
- 8.19. *Each unit directory provides a valid Unit\_Spec\_Id and Unit\_Sw\_Version*  
Required
- 8.20. *Each unit directory provides a pointer to a unit-dependent directory*  
Required
- 8.21. *Vendor and model leaves support textual descriptor leaf format*  
Required
- 8.22. *Unit-dependent directory provides a pointer to the unit's CSRs*  
Required
- 8.23. *Device provides more than one connector port*  
Recommended
- 8.24. *Device uses the approved IEEE 1394 connectors*  
Required
- 8.25. *Self-powered devices propagate the power bus through each connector*  
Required
- 8.26. *Only single-port leaf-node devices use 4-pin connectors*  
Required
- 8.27. *Device connectors exhibit common speed and power characteristics*  
Required
- 8.28. *Standard S400-rated IEEE 1394 cable is provided with devices*  
Required
- 8.29. *Devices provide sufficient power to their PHY at all times*  
Required
- 8.30. *Devices report power source and cable power consumption in Self\_id packet*  
Required
- 8.31. *Devices implement link power control*  
Required
- 8.32. *Device requiring power increments in excess of Link\_on implements unit-power CSRs*  
Required
- 8.33. *Devices that source cable power must report this capability*  
Required



*8.34. IEEE 1394-enabled PC sources cable power*

*Required*

*8.35. Power source supplies a minimum of 20 volts at 15 watts*

*Recommended*

*8.36. Devices notify the power manager of power change requests*

*Required*

*8.37. Devices and controllers comply with Cable Power Distribution specification*

*Required*

*8.38. Devices and controllers comply with IEEE 1394 power specification*

*Required*